PROCESS CONTROL

Contactless Measurement of Level

LB 440

BERTHOLD TECHNOLOGIES

Level Gauge LB 440

The measuring system **LB 440** is used for the **contactless, continuous** measurement of liquids and bulk materials in reactors, vessels and bunkers. The measurement is not affected by the chemical and physical properties of the product being measured. The level measurement is adapted to the specific geometry of the vessel.

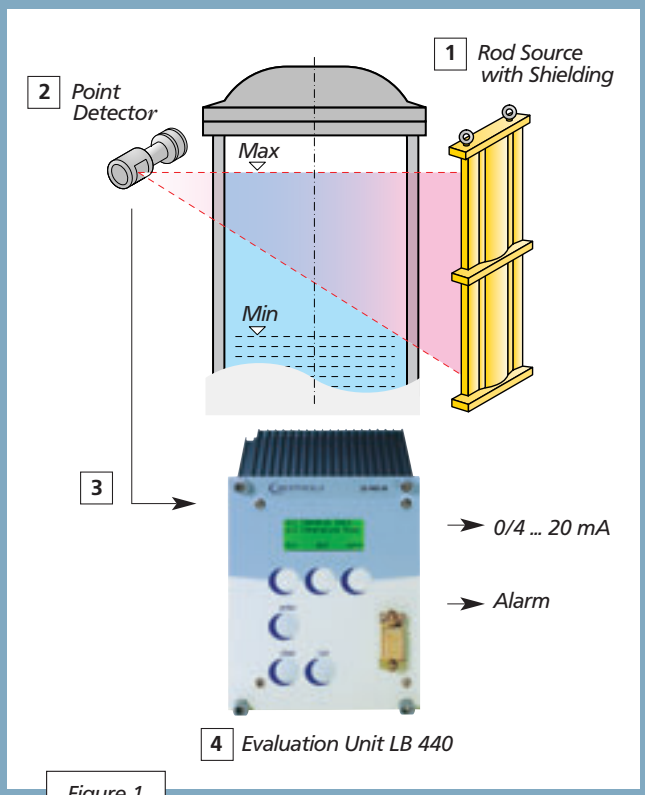


Figure 1

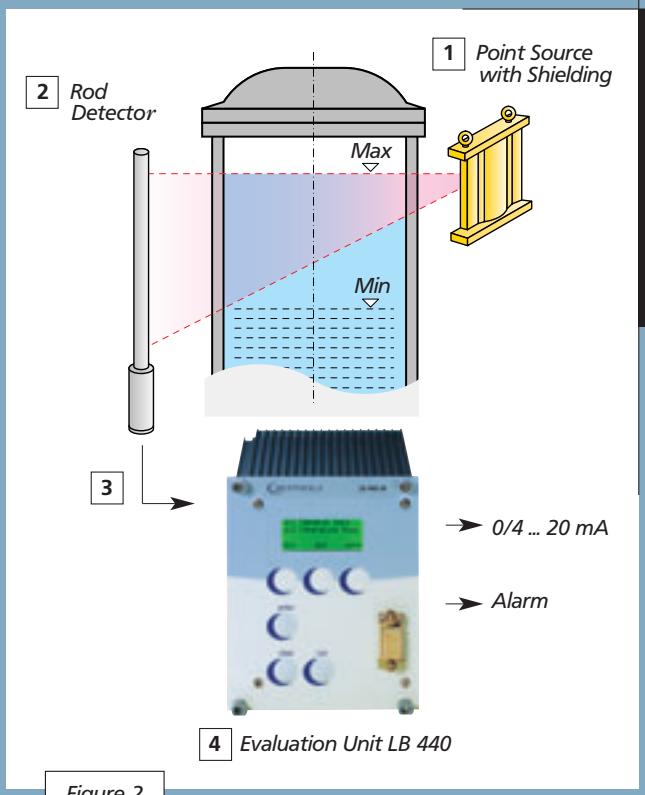
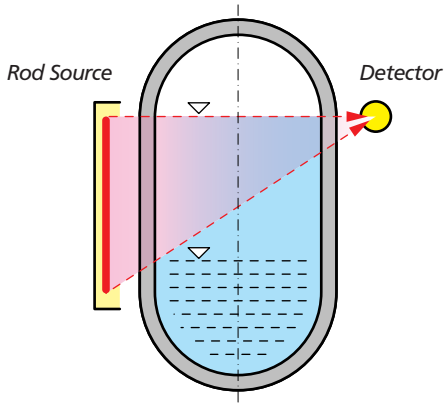


Figure 2

Measuring Arrangement

Figures 1 and 2 show schematic layouts of typical measuring arrangements. It is comprised of the source [1] mounted on the outside of the container, a detector [2] and the connection cable [3] from the detector to the evaluation unit LB 440 [4]. Source and detector form a radiation field corresponding to the size of the measuring range. This can be achieved by using a rod-shaped source and a point detector (Fig. 3) or a point-shaped source and a rod detector (Fig. 4), for special applications a rod source and rod detector (Fig. 5) can be used. Which of these options is selected is dependent upon the measuring geometry, the measuring task, ambient factors or even considerations of space and money. For larger measurement ranges several rod detectors can be used together in a line. Signals from individual detectors are transmitted via slave units to a master evaluation unit for indication of product level.

General Arrangements



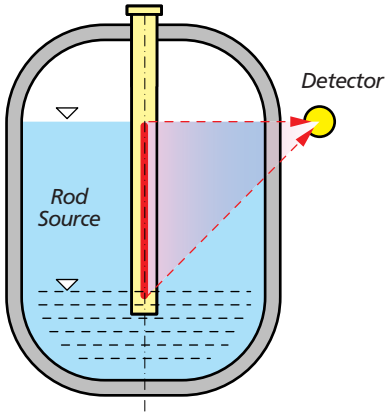
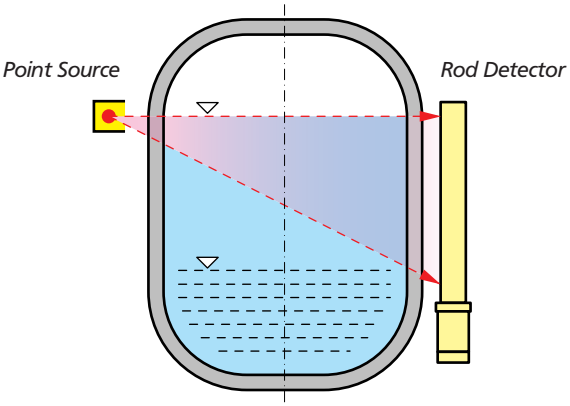


Figure 3: **Rod Source**



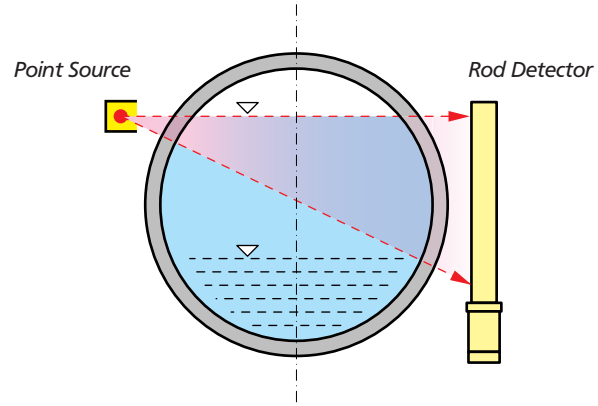
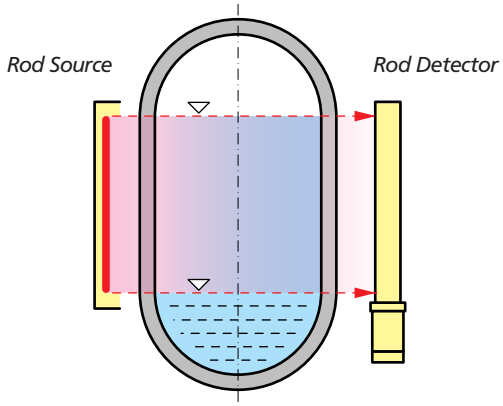


Figure 4: **Rod Detector**



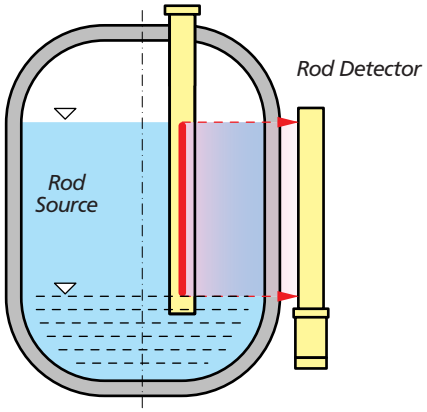


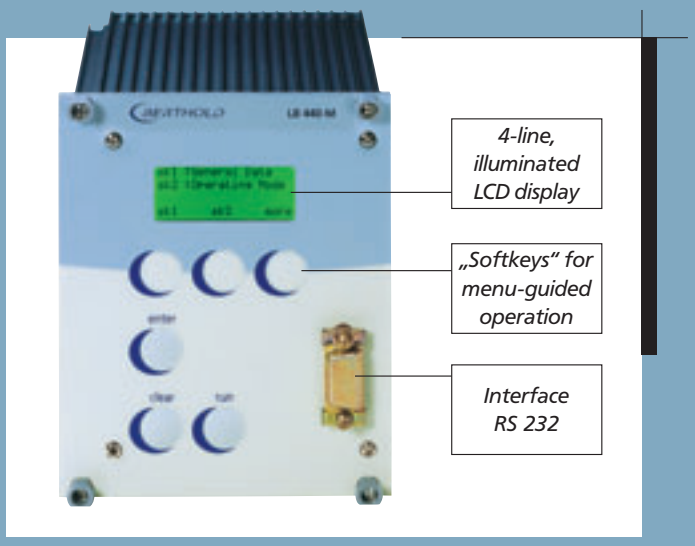
Figure 5: **Rod Source with Rod Detector**

Evaluation Unit LB 440

The evaluation unit incorporates state of the art microprocessor technique with 32-bit processor for high computing performance and high accuracy together with most simple operation. The software is tailored to the measuring principle. More than 40 years of experience in the field of radiometric measurement technique are consequently utilized.

In addition, the evaluation unit features:

- Compact design in 19"-module (3HE; 21 TE) for installation in a wall housing or 19"racks.
- Illuminated 4-line LCD-display.
- Operation via 6 membrane keys.
- Convenient multilingual and user-guided dialog via "softkeys".
- Continuous self-monitoring of the electronics.
- Data protection without battery backup by saving all calibration data to a FLASH-Memory.



Source with Shielding

All radioactive sources used for industrial applications are encapsulated in stainless steel, so that radioactive substance is kept separate and isolated from the material beeing measured. Depending on the measuring task, one can either work with ^{60}Co or ^{137}Cs sources. The radioactive material of the ^{60}Co rod source is a metal wire wound around a mandrel of the required length. By winding at a variable pitch, any linearization can be achieved, even for complicated measuring geometries. Depending on the measuring task, either ^{60}Co or ^{137}Cs are selected as point sources. The sources are built into sturdy shieldings which include a lockable radiation exit slit that is directed toward the detector. The shielding is adapted to the required activity so that operating personnel are never exposed to any excessive radiation levels. For rod sources as well as for point sources, the shielding is installed **vertically** on a bracket. The radiation channel is specially designed for this measuring arrangement. This ensures a simple and non-critical installation.

Detectors

Typically, scintillation counters are used as radiation detectors for continuous level measurements. These detectors consist of a NaI crystal; the scintillator of rod detectors are made of plastic. Flashes of light are created in the detector by the radiation. The number of flashes is proportional to the intensity of the radiation field. The crystal is optically coupled to a photomultiplier which, together with the electronics, converts the flashes of light into electrical pulses.

The special benefits of scintillation counters are their high sensitivity to Gamma radiation, low source activity and unlimited useful life. The signals are transfered to the evaluation unit via two-wire technique with FSK-modulation to ensure a high level of interference immunity.

Contactless Measurement

Principles of Measurement

The Level Gauge LB 440 operates according to radiometric principle, utilizing the physical law that gamma radiation is attenuated as it passes through matter. Since the source type and the absorption path are constant in this case, the measurement is affected only by the presence of the medium. All other physical properties such as pressure, temperature, viscosity and colour have no influence. Since the absorption law follows an exponential curve, the measuring effect with normal container dimensions becomes practically independent of any density changes in the medium being measured.

As a consequence, the radiometric measuring method features a very high level of operational safety and requires practically no maintenance, even under difficult operating and ambient conditions. The use of scintillation counters as radiation detectors and careful project engineering ensure that the lowest possible source activities and the best shieldings will be used. The radiation exposure of the operating staff will clearly stay below the extremely low values permitted by law, which are about as high as the natural environmental radiation. The use of radiometric measuring systems has to comply with the applicable radiation protection regulations.

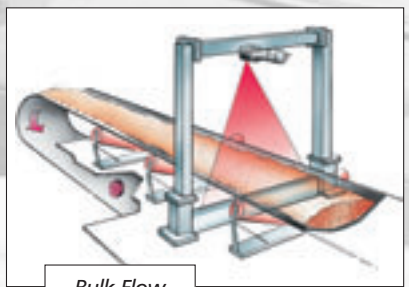
Project Engineering

When designing the level gauging system, the special features of the production process and possible contingent conditions should be taken into account, in addition to the actual measuring task.
Relevant data along with dimensional drawings should therefore be provided.

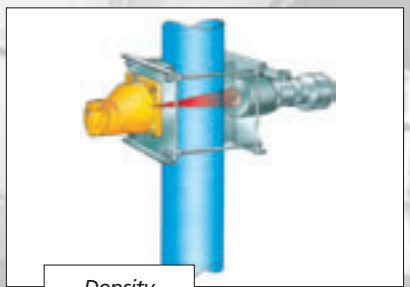
Engineering Data

- **Type and dimensions of the vessel**
- **Wall thickness and wall material**
- **Thickness and density of any insulation**
- **Size and position of the required measuring range**
- **Density and any special properties of the medium in vessel**
- **Gas density under operating conditions in high pressure systems**
- **Maximum speed of level variations**
- **Ambient temperature at the detector**
- **Agitators or other internals, if any**

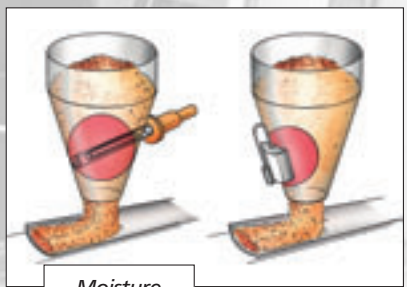
Other Applications from Berthold



Bulk Flow



Density



Moisture

Technical Data LB 440

Evaluation Unit LB 440

Design	19" module 3 HE, 21 TE protection class IP 20
Weight	approx. 2 kg
Power supply	115/230 V AC +/– 10 % 18-32 V DC, 24 V AC
Power consumption	approx. 30 VA (AC) 30 W (DC)
Operating temp.	0 ... +50° C (273 bis 323 K) no condensation
Storage temp	-40 ... +70° C (233 bis 343 K) no condensation
Arrangements	in a panel in a 19" rack (max 4 Units) wall mounted cabinet
Detector connection	[EEx ib] IIB [EEx ib] IIC (Option)
Current output	4-20 mA, isolated impedance max. 500 Ohm
Digital inputs	external start/stop
Digital output	1 relay for failure message, SPST 2 relays for threshold, SPST max load: (non inductive) AC: max. 250 V, max. 1 A, max. 200 VA DC: max. 300 V, max. 1 A, max. 60 W
Interfaces	RS 232 on front site / RS 485 rear
Multi lingual operation	English, German, French

Berthold Technologies reserves the right to implement technical improvements and/or design changes without prior notice.

Probes

Housing	Nema 4X and IP 65 Stainless Steel	
Cable entrance	M16	M12
Cable diameter	5 ... 10 mm	4 ... 7 mm
Connection cable	LiYCY 2 x 1 mm²	
Max. cable length	with Berthold cable #32024	
	EEx ib IIB	EEx ib IIC
	1000 m	250 m

Explosion Proof

ATEX	Ⓔx II 2G EEx de IIC T6 Ⓔx II 2G EEx ib d IIC T6
Dust (on request)	Ⓔx II 2 D IP65 T 80° C
FM (option)	Class I Division 1 Group A, B, C, D Class II Division 1 Group E, F, G Temp. Class T6 (85° C)

Point Probes

NaI (Tl) Scintillation counters with automatic drift compensation

Temp. stability	+/– 0,1 % (at –20 ... +50° C)		
Operating temp.	– 40 ... +60° C (233 ... 333 K)		
Storage temp.	– 40 ... +70° C (233 ... 343 K)		
Water cooling	option		
	Crystall size	Dose rate (µSv/h) for 300 cps	Weight (kg)
LB 4401-01	25/25	2,7	6
LB 4401-02	40/35	1,1	6
LB 4401-03	50/50	0,5	18

Rod Detectors

Plastic scintillation counters with automatic drift compensation

Temp. stability	+/– 0,5 % (at –20 to +50° C)
Operating temp.	– 40 ... +55° C (233 ... 328 K)
Storage temp.	– 40 ... +55° C (233 ... 328 K)
Water cooling	option

Typical dose rate at empty: 1µSv/h

Type	Sensitive detector length (mm)	Dose rate (µSv/h) 1000 cps	Weight (kg) without water cooling	Weight (kg) with water cooling
LB 4405-01	500	0,17	9	11,5
LB 4405-02	750	0,15	10,5	14
LB 4405-03	1000	0,09	12	17
LB 4405-04	1250	0,07	13,5	19,5
LB 4405-05	1500	0,06	15	22
LB 4405-06	2000	0,04	16,5	25